Technology Subcommittee (TSC) Report to the Earth System Science and Applications Advisory Committee (ESSAAC)

Dr. Fawwaz Ulaby, Chair
University of Michigan

July 16, 2003

Background

Why

- The Earth Science Biennial Review (June 1997) recommended that future missions be implemented with shorter development time and using the best suitable technology.

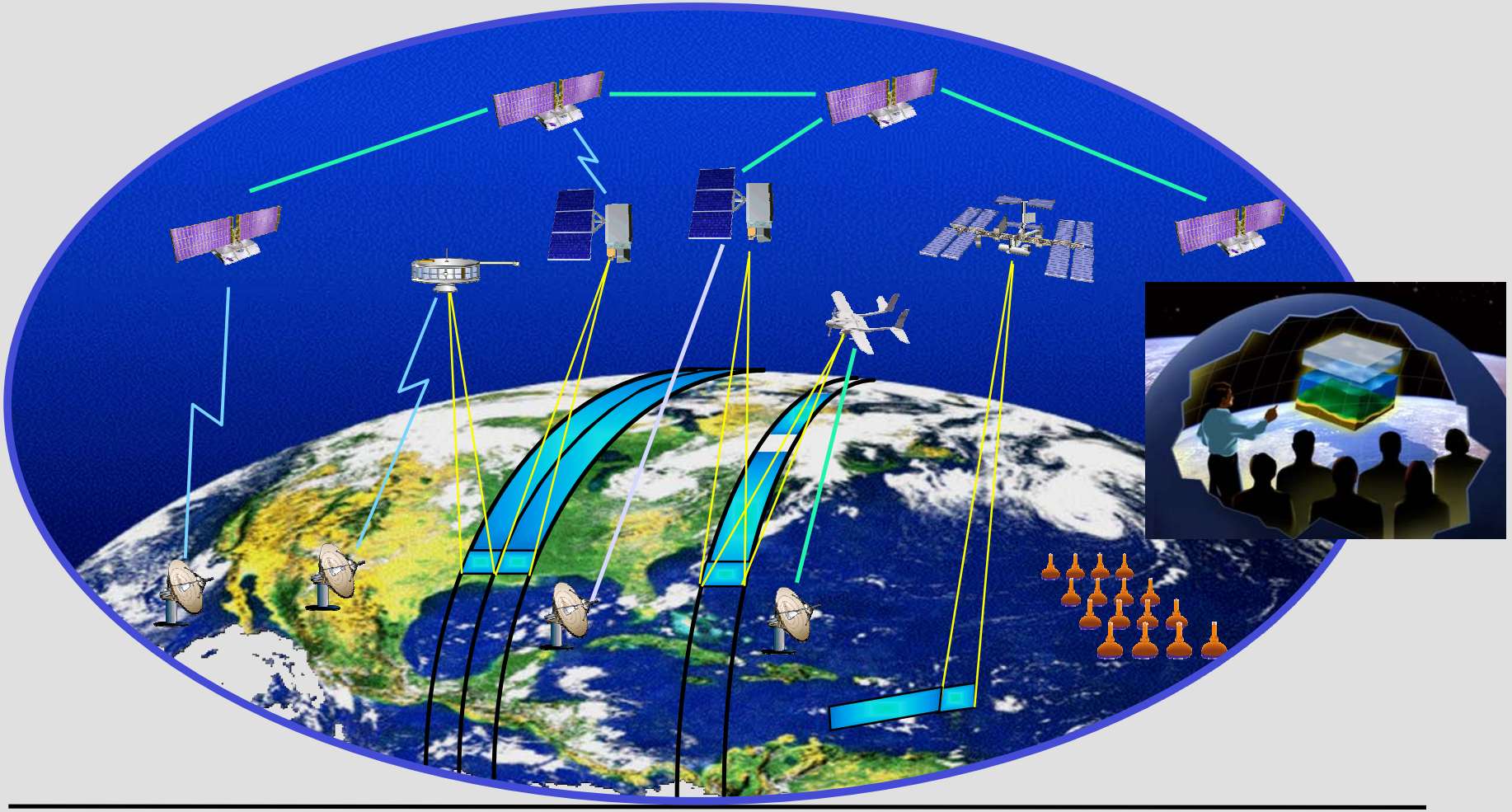
- The resulting plan included the establishment of a flexible, science-driven technology strategy that would develop very specific technologies via a competitive selection process and provide a broad portfolio of emerging technologies for infusion into a range of missions.

- To meet these challenges the Earth Science Technology Program was established and the Earth Science Technology Office (ESTO) created in March 1998.

- The ESTP consists of two major components:
  - **ESTO:** technology development programs in the low-to-mid technology readiness levels
  - **New Millennium Program**: technologies requiring in-space qualification

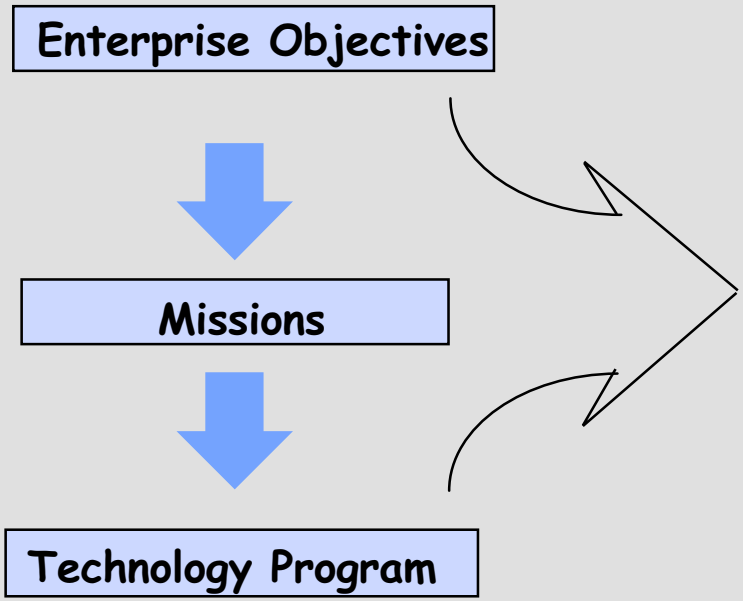
Integrated Observing System of the Future

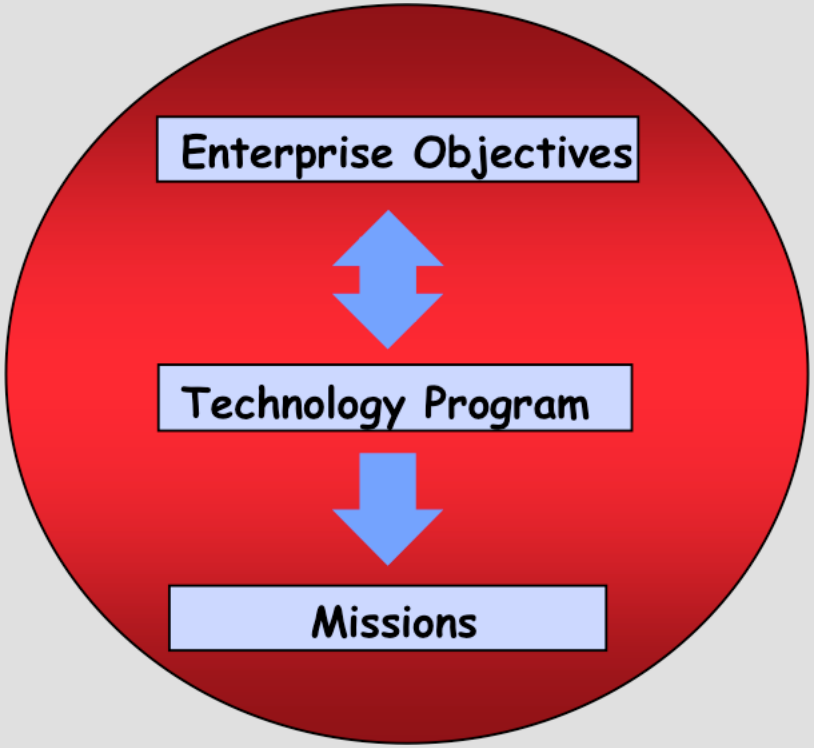
- Information Synthesis: Distributed, Reconfigurable, Autonomous
- Access to Knowledge: On-orbit Processing, Immersive Environments



Shift from Technology Derived from Missions to Missions Enabled by Technology

Why





PAST:

Enterprise objectives established

Missions sets derived from Enterprise objectives

Technology programs derived From mission requirements

PRESENT:

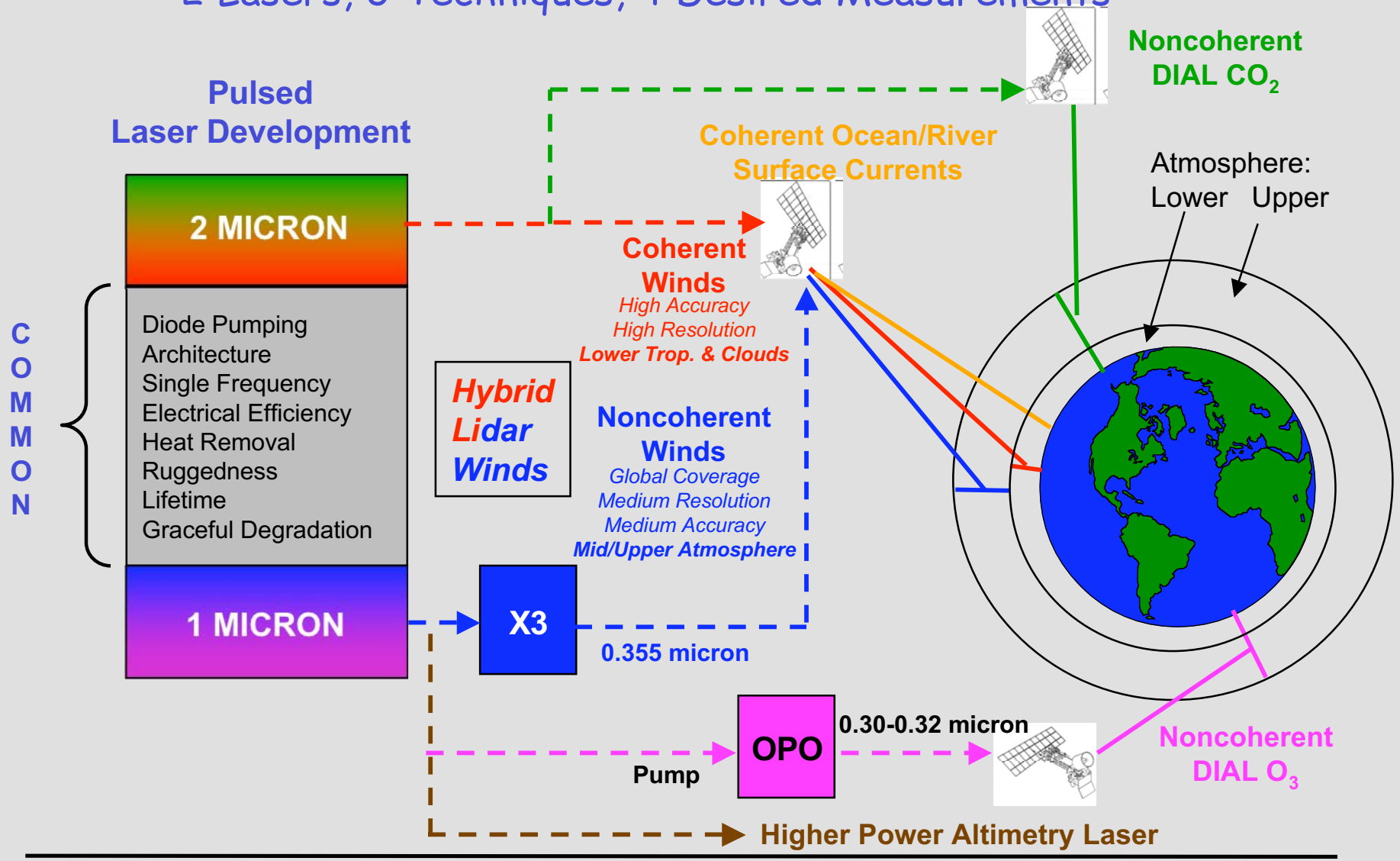
Enterprise objectives drive technology

Technology expands mission horizons

Missions evolve from convergence of objectives and technology

Risk Reduction - Laser Technology Example

2 Lasers, 3 Techniques, 4 Desired Measurements



ESTO Technology Program Elements

What

- **Advanced Technology Initiatives (ATI)**—provides for concept studies and development of component and subsystems technologies for instruments and platforms

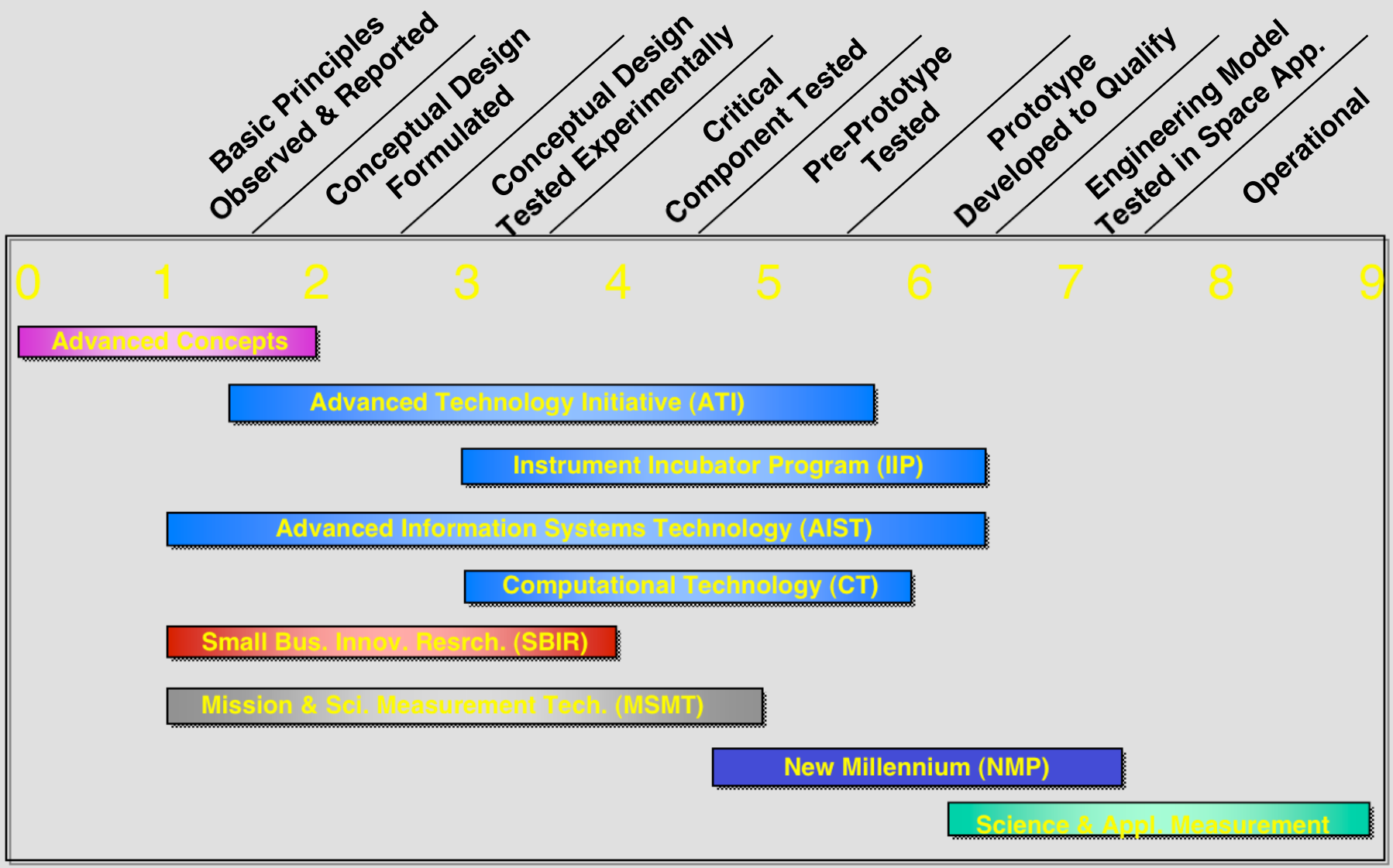
- **Instrument Incubator Program (IIP)**—provides new instrument and measurement techniques including lab development and airborne validation

- **Advanced Information Systems Technologies (AIST)**—provides on-orbit or ground capabilities allowing for more autonomous and efficient generation and operational control of remotely sensed data and information

- **Computational Technologies (CT)**—provides techniques and systems that enable high performance throughput, archiving, data manipulation, and visualization of very large, highly distributed remotely sensed data sets consistent with modeling needs

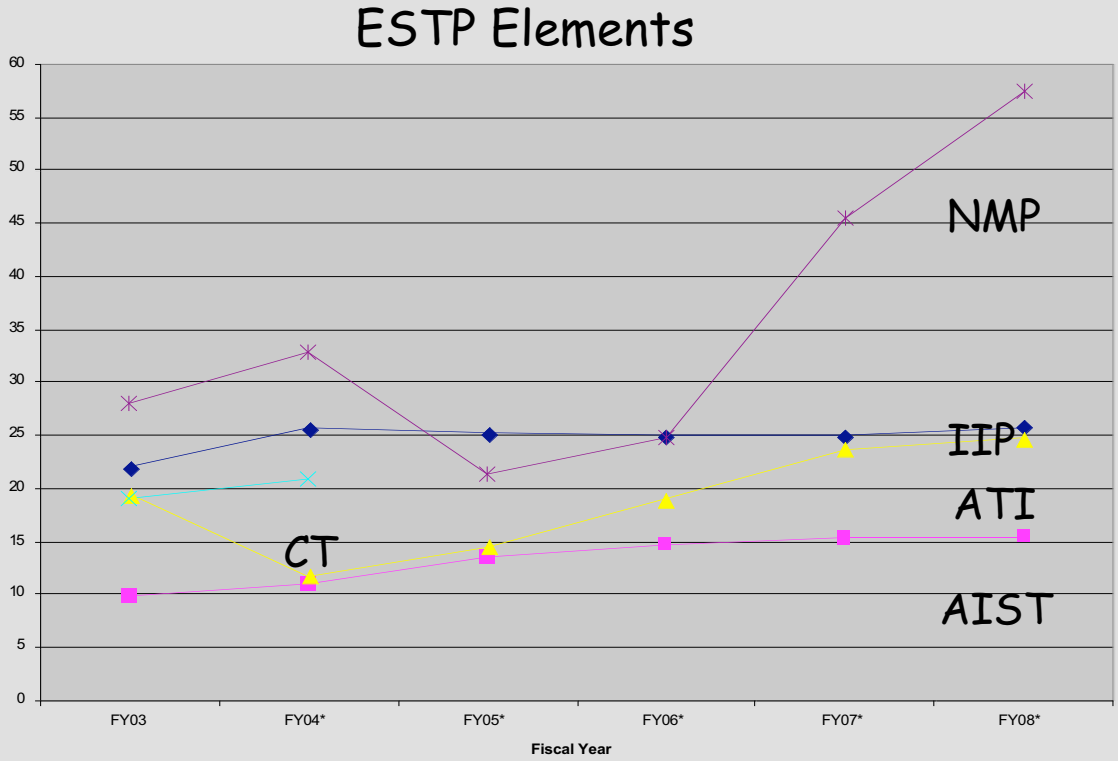
Technology Program Readiness Levels

How



Earth Science Technology Program Budget

The overall ESTP (ESTO and NMP) is funded at about $108 M in FY 04, but dips to near $80 M in FY05-06 largely due to discontinuation of the CT program in FY05, and the returns to about $110 M in FY 07



Note:

1. Full cost accounting in FY04 and out
2. Budgets for FY04 and out are proposed

Strategic Process for Technology Development

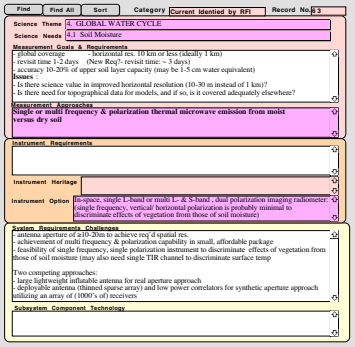
How

What needs to be done?

Science and Application Questions
Themes/Needs (Direct and Derived)
Goals/Requirements

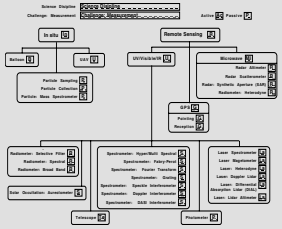
Technology
Planning
Database

(ESTIPS)



What approach?

Technology Approach



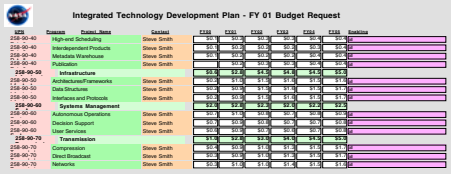
Active Instruments
Passive Instruments
Platforms
Info Systems

Gap Analysis

What and when we do it

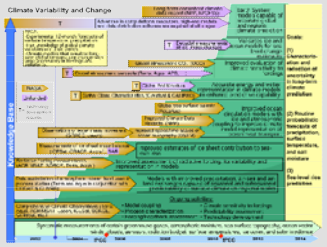
ITDP

Funded technology development
ATI, IIP, AIST, CT, NMP



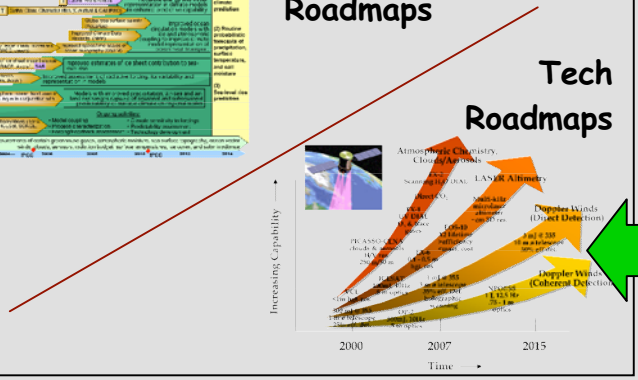
NASA Technology Inventory

What tools?



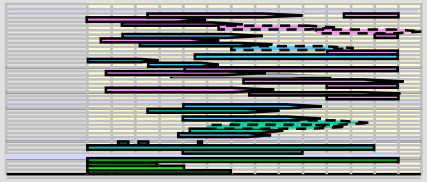
Science Roadmaps

Tech Roadmaps



Where we infuse?

Science & Applications
Implementation

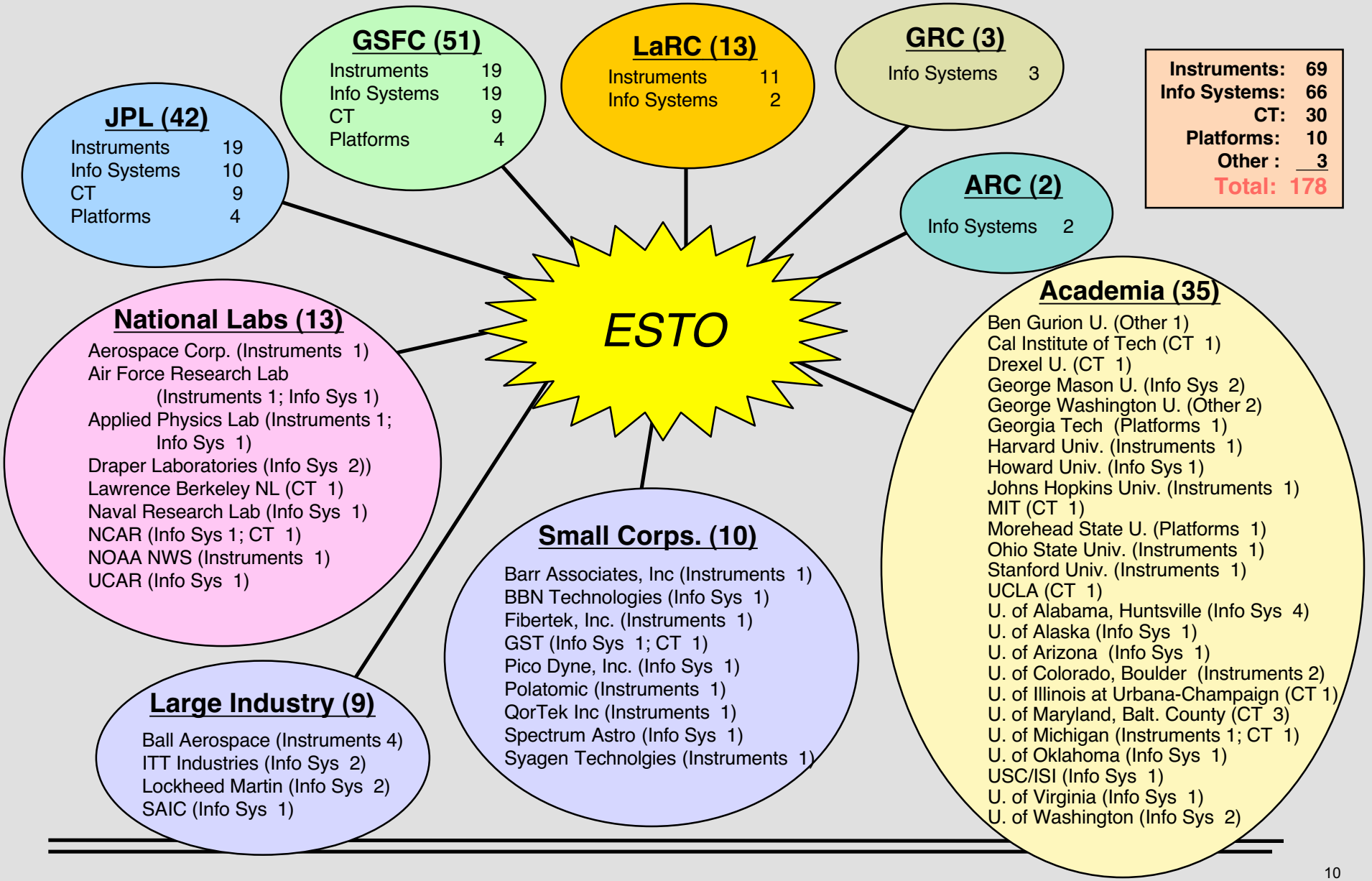


Infusion Plan

Tech. Readiness Assessments

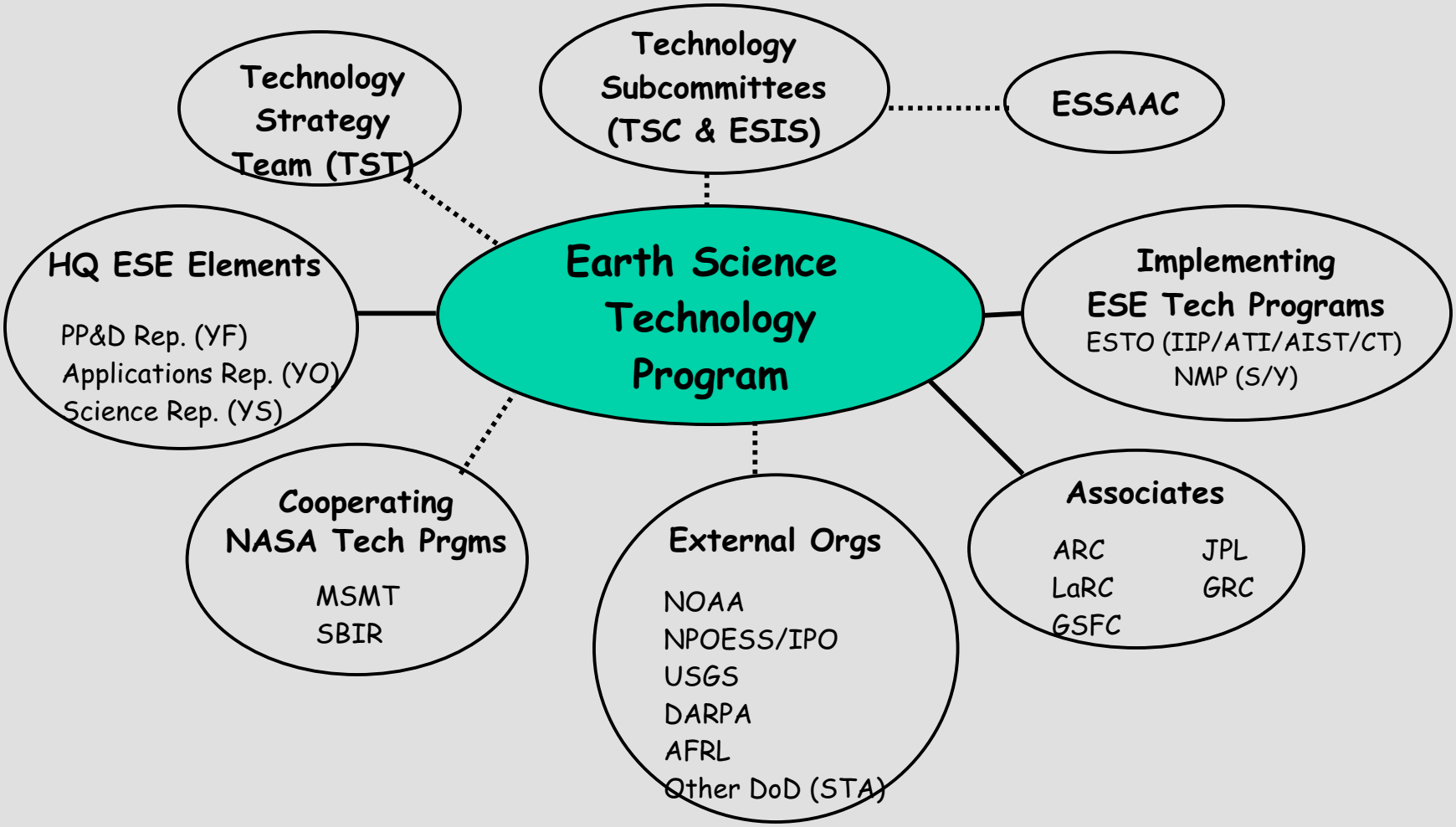
ESTO Active Projects Portfolio (FY02-03)

What



Technology Program Coordination

Who



Technology Maturation and Infusion

Outcome

- Technology being successfully matured
  - 77% of all completed projects have advanced at least 1 TRL
    - IIP-1: 26 of 27 (27 completed)
    - ATI-1: 22 of 23 (8 completed)
    - AIST-1: 28 of 30 (10 completed)
  - 79% of all completed projects have advanced to TRL 3 or greater

- Technology being successfully infused
  - 35% of all completed projects infused into science campaigns, EO-1, ESSP-3 proposals and other programs/projects
    - 8 IIP-1 projects have flown on aircraft as demonstration and/or campaign flights
  - 45% of all completed projects have identified projected or planned infusion

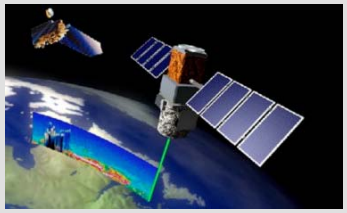
- Facilitating technology infusion
  - Technology planning and roadmapping to identify future needs
  - Task management through ESTO Associates at NASA Centers with relevant competencies
  - Broad dissemination/communication of activities with PI communities
  - Active flight demonstration/validation through the New Millennium Program

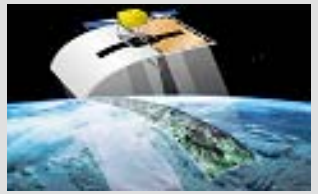
Note: TRL = 0, 1, 2 are primarily early AIST Prototyping, and Studies

Key Technology Challenges

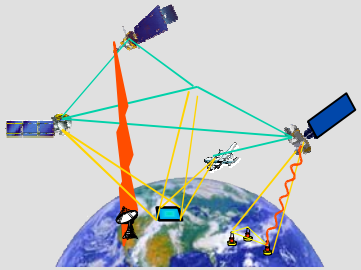
Challenges to Enable Future Science

- Laser/Lidar technology to enable atmospheric science measurements





- Large Deployables to enable future weather/climate/ natural hazards measurements



- Intelligent Distributed Systems using optical communication, on-board reprogrammable processors, autonomous network control, data compression, high density storage

- Information Knowledge Capture through 3-D Visualization,

ESSAAC Technology Subcommittee (TSC)

Report from June 18, 2003 Meeting

- **In attendance:** Fawwaz T. Ulaby, **U of Michigan (chair)**
  William Brown, **MIT** Sara Graves, **U of Ala.-Huntsville**
  Michael Hardesty, **NOAA** James Hendler, **U of Maryland**
  Kristine Larson, **U of Colorado** Robert Weiss, **Physical Sciences, Inc.**

- Agenda
  Welcome · **Ghassem Asrar/NASA HQ**
  Member Introduction / Committee Charge · **Fawwaz Ulaby/Univ. Michigan**
  Overview of Earth Science Technology Pgm · **Gran Paules/NASA HQ**
  ES Technology Program Strategy · **J.C. Duh/ESTO**
  Science is the Technology Driver · **Jack Kaye/NASA HQ**
  Earth Science Technology Office Presentation · **George Komar/ESTO**
  New Millennium Program · **Chris Stevens/JPL**
  Visions 2030 · **Peter Hildebrand/GSFC**
  Summary of Program Challenges · **Gran Paules**

TSC Observations and Recommendations

1. Endorses ESE view that technology is an "enabler" of science missions
2. Endorses and supports the "Technology Roadmap" with the following suggestions and concerns:
   a) Add interim milestones to roadmap objectives
   b) Incorporate some flexibility into roadmaps to ease the adoption of emerging technology
   c) Tone down the optimism; allow some room for setbacks and slower-than-anticipated development of technologies
   d) Projected funding levels are inadequate; increase by at least 10% per year for next five years
3. Conduct technology validation on NASA-controlled spacecraft

TSC Observations and Recommendations

4. Add tools for usability and packaging of data to ESE capabilities.
5. Integrate the development of ESE technology groups (satellite sensors, telecom systems, IT) with science goals and objectives.
6. Put IT NRAs on 12-18 month cycle consistent with rapid development typical in this area.
7. Spatial/temporal transformations of sensor observations deserve special attention.

Future Steps

1. Add two members to TSC: Bruce Wallace, Army Research Lab, and Daniel Reed, Univ. of Illinois-Urbana/Champaign.
2. Hold Fall, 2003 meeting at NASA Goddard Flight Center to discuss active and passive optical sensors.